

# Introduction

- Dave Anders aka prpplague

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- Currently Contracted with TI

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- Partners in TinCanTools

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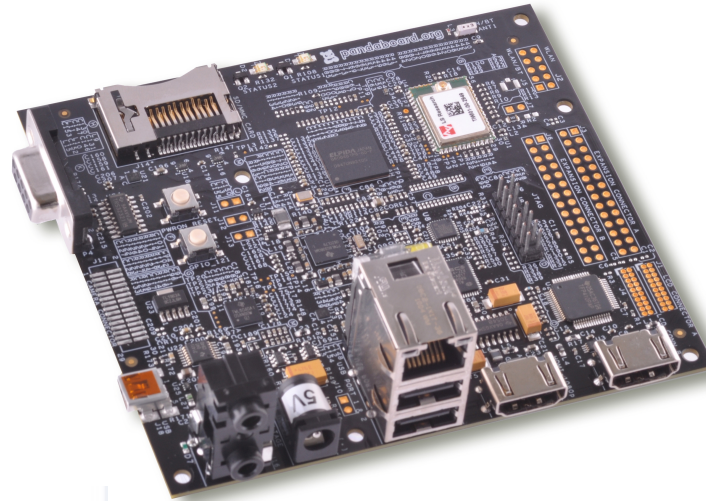
- Dave Anders aka prpplague
- Currently Contracted with TI
- Partners in TinCanTools
- Low Cost Power Measurement

# Introduction

- Dave Anders aka prpplague
- Currently Contracted with TI
- Partners in TinCanTools
- Low Cost Power Measurement
  - Challenges
  - Choices

# Challenges

- Development Boards



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- Ohms Law
  - $V = I \times R$
  - $I = V / R$
  - $R = V / I$

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- Development Boards
- Ohms Law
  - $V = I \times R$
  - $I = V / R$
  - $R = V / I$
  - Example
    - Measured Voltage = 0.0175V

# Challenges

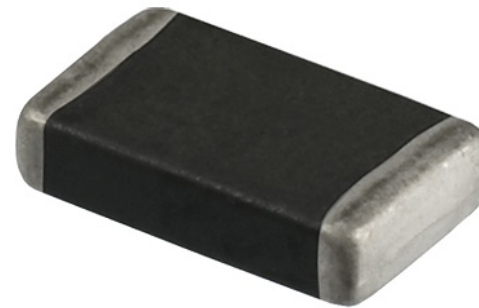
- Development Boards
- Ohms Law
  - $V = I \times R$
  - $I = V / R$
  - $R = V / I$
  - Example
    - Measured Voltage = 0.0175V
    - Shunt Resistor = 0.05 Ohms

# Challenges

- Development Boards
- Ohms Law
  - $V = I \times R$
  - $I = V / R$
  - $R = V / I$
  - Example
    - Measured Voltage = 0.0175V
    - Shunt Resistor = 0.05 Ohms
    - $0.0175 / 0.05 = 0.350A$

# Challenges

- Development Boards
- Ohms Law
- Shunt Resistor
  - Low resistance
  - Very accurate



# Challenges

- Development Boards
- Ohms Law
- Shunt Resistor
- Placement
  - Cutting Traces
  - Lifting Pins
  - Replacing Parts

# Challenges

## SMPS Power Inputs & Outputs

DGND

### VCORE1 SMPS

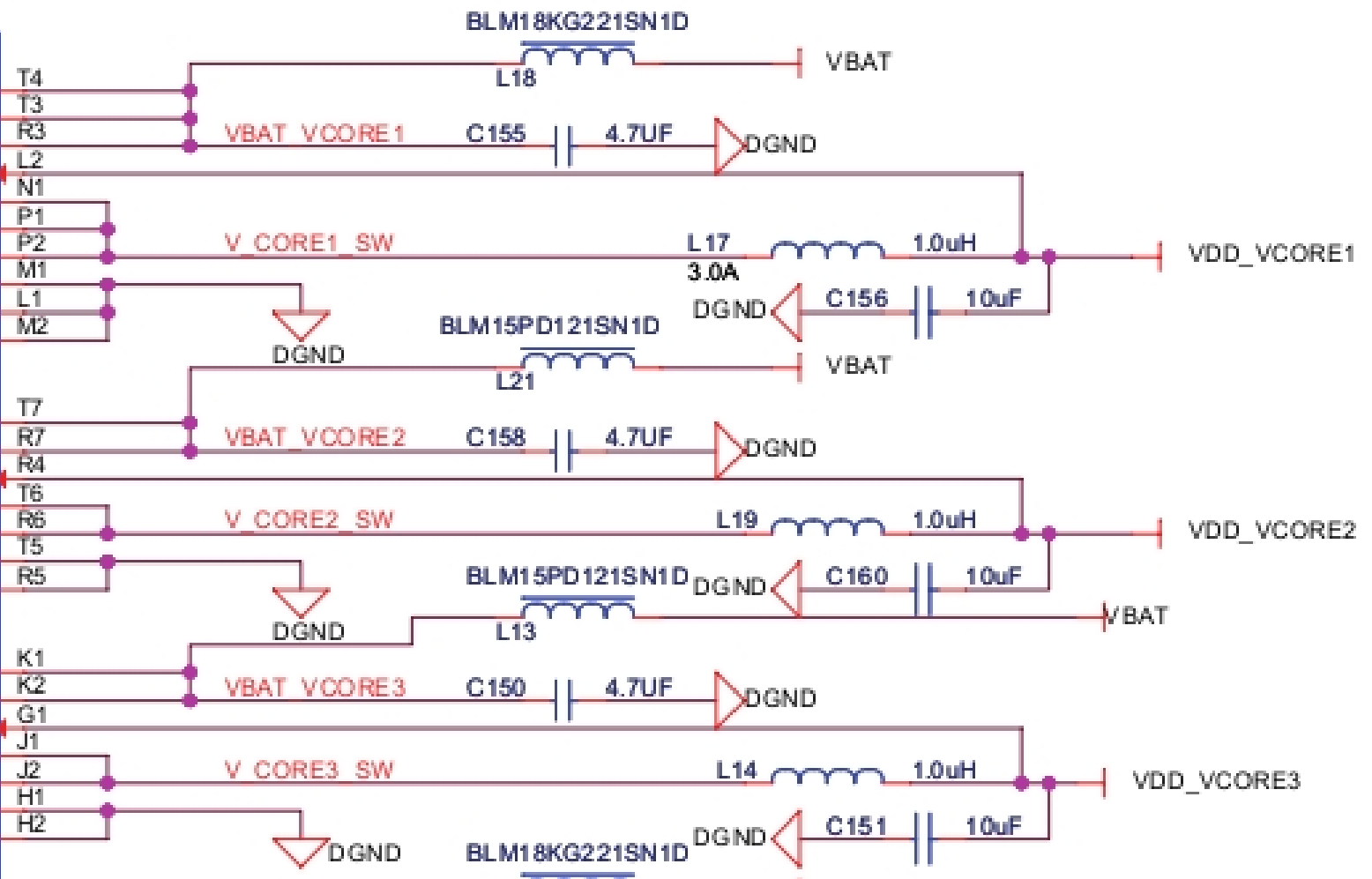
VCORE1\_IN\_B1  
VCORE1\_IN\_B2  
VCORE1\_IN\_B3  
VCORE1\_FDBK  
VCORE1\_SW\_B1  
VCORE1\_SW\_B2  
VCORE1\_SW\_B3  
VCORE1\_GND\_B1  
VCORE1\_GND\_B2  
VCORE1\_GND\_B3

### VCORE2 SMPS

VCORE2\_IN\_B1  
VCORE2\_IN\_B2  
VCORE2\_FDBK  
VCORE2\_SW\_B1  
VCORE2\_SW\_B2  
VCORE2\_GND\_B1  
VCORE2\_GND\_B2

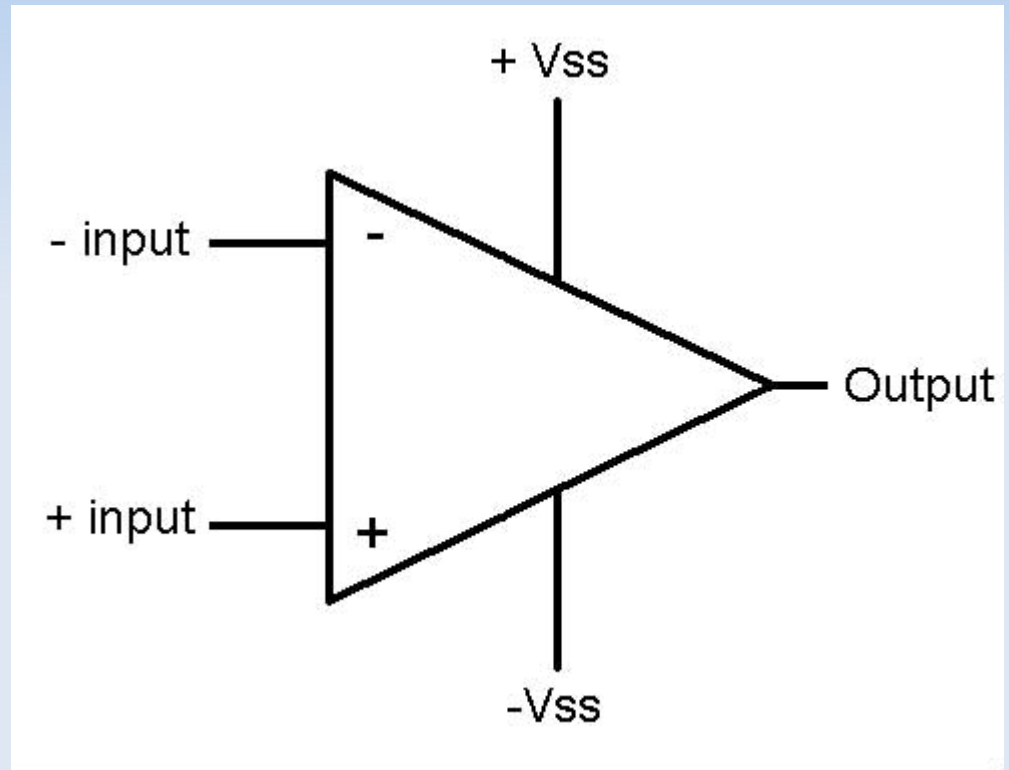
### VCORE3 SMPS

VCORE3\_IN\_B1  
VCORE3\_IN\_B2  
VCORE3\_FDBK  
VCORE3\_SW\_B1  
VCORE3\_SW\_B2  
VCORE3\_GND\_B1  
VCORE3\_GND\_B2



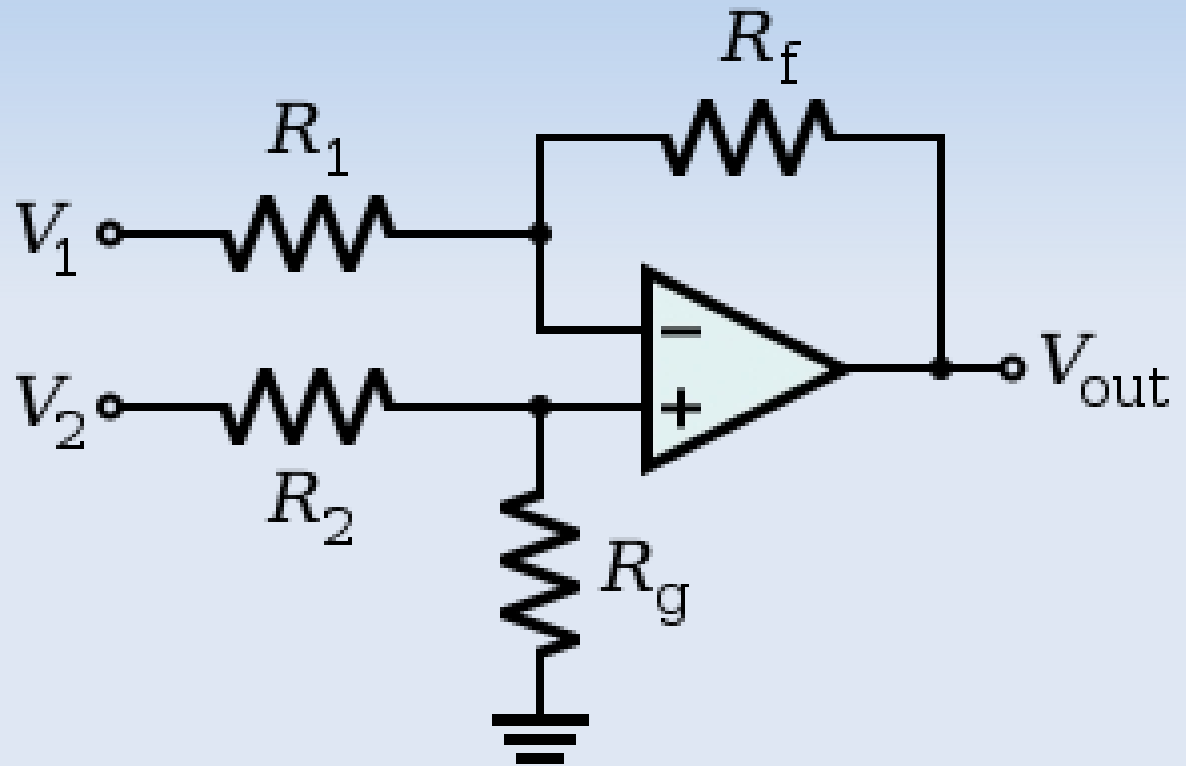
# Challenges

- Development Boards
- Ohms Law
- Shunt Resistor
- Placement
- Opamp



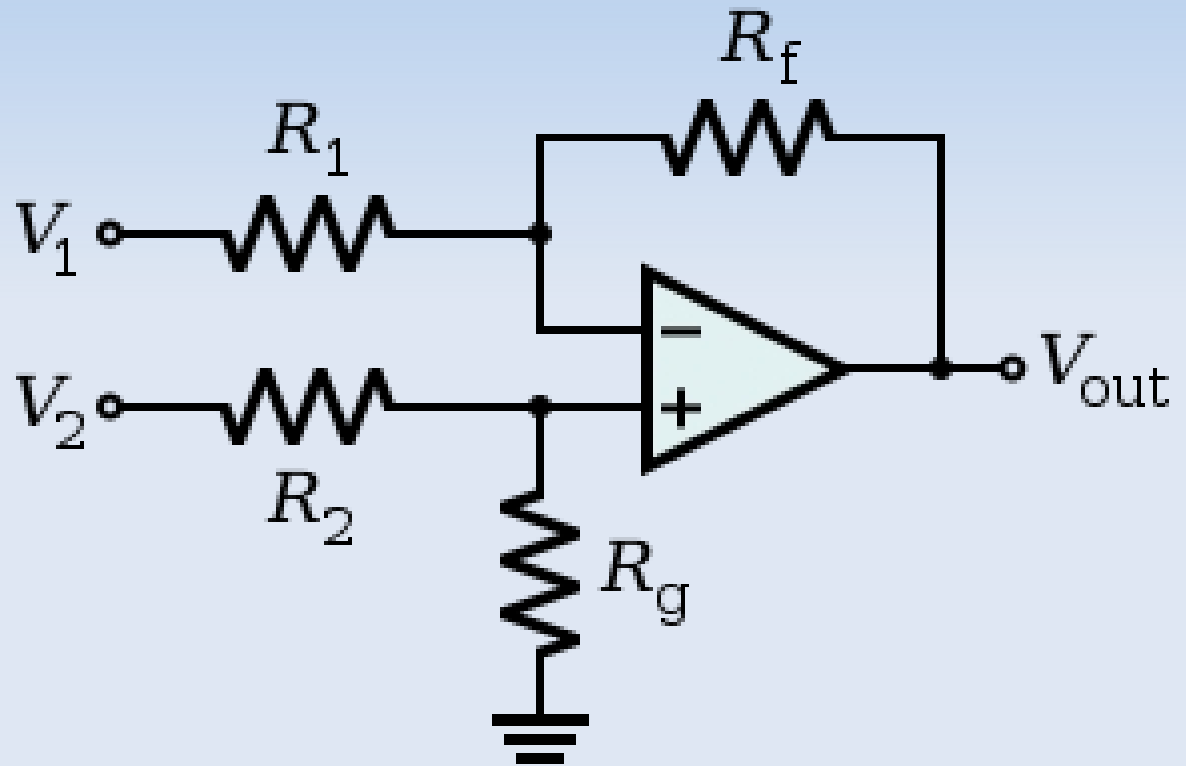
# Challenges

- Development Boards
- Ohms Law
- Shunt Resistor
- Placement
- Opamp
  - Scale Voltage



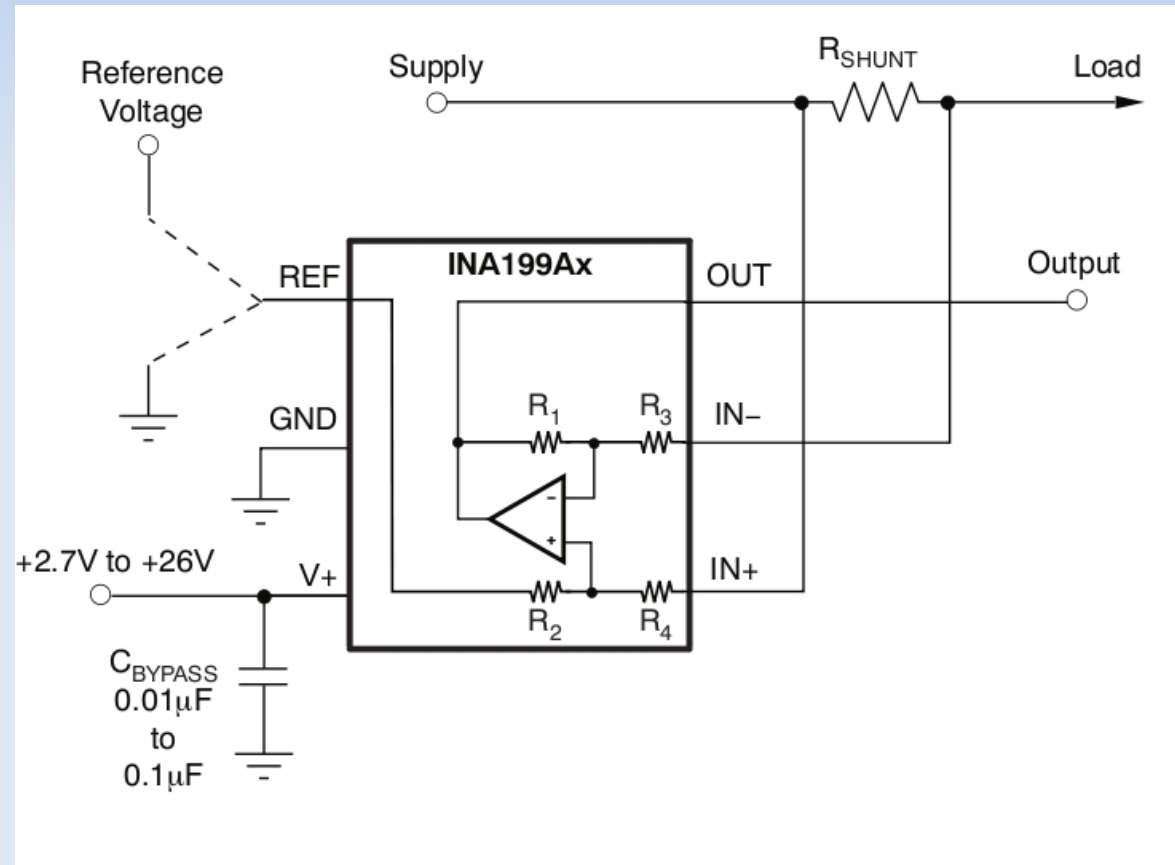
# Challenges

- Development Boards
- Ohms Law
- Shunt Resistor
- Placement
- Opamp
  - Scale Voltage
  - Resistors



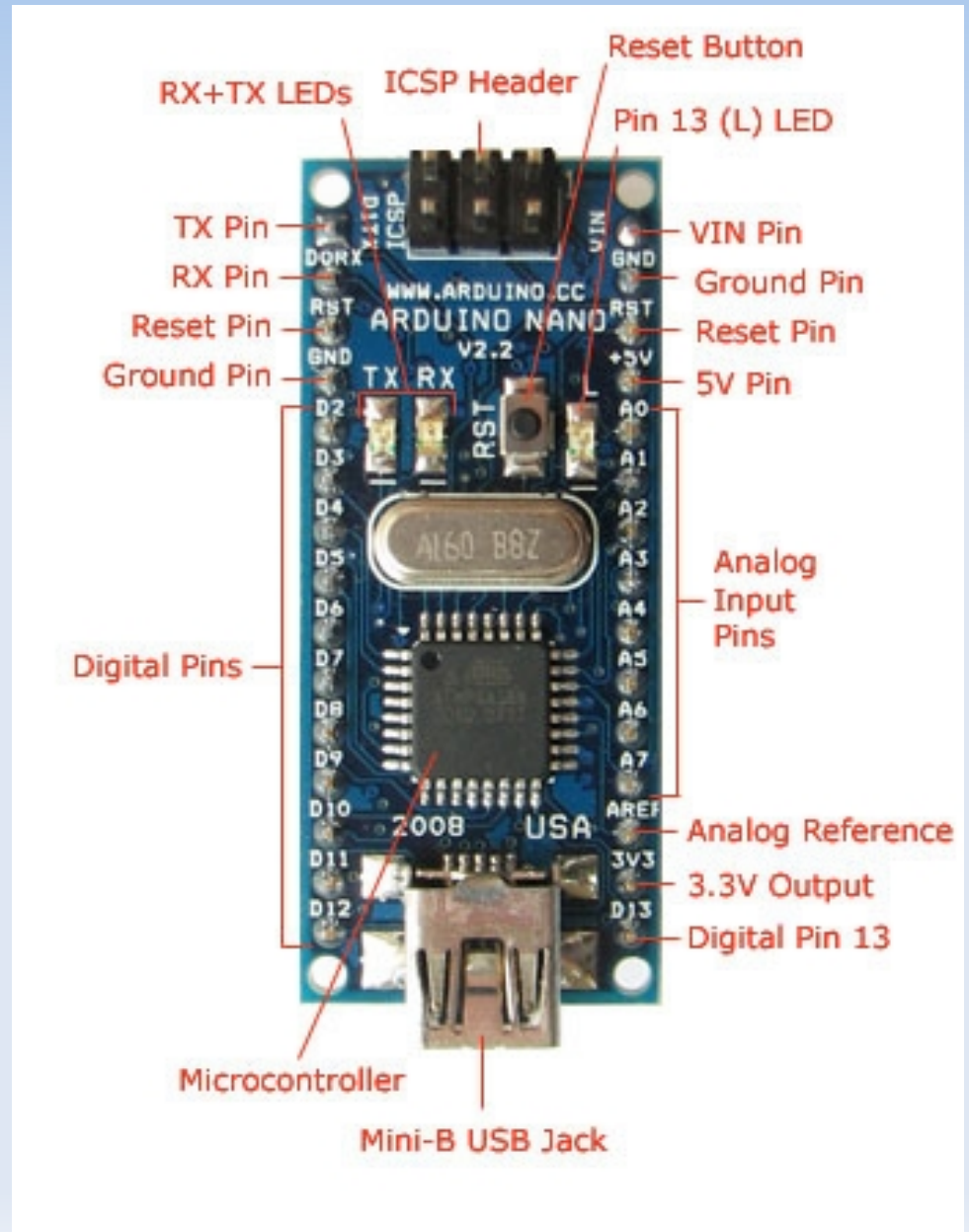
# Challenges

- Development Boards
- Ohms Law
- Shunt Resistor
- Placement
- Opamp
  - Scale Voltage
  - Resistors
  - INA199



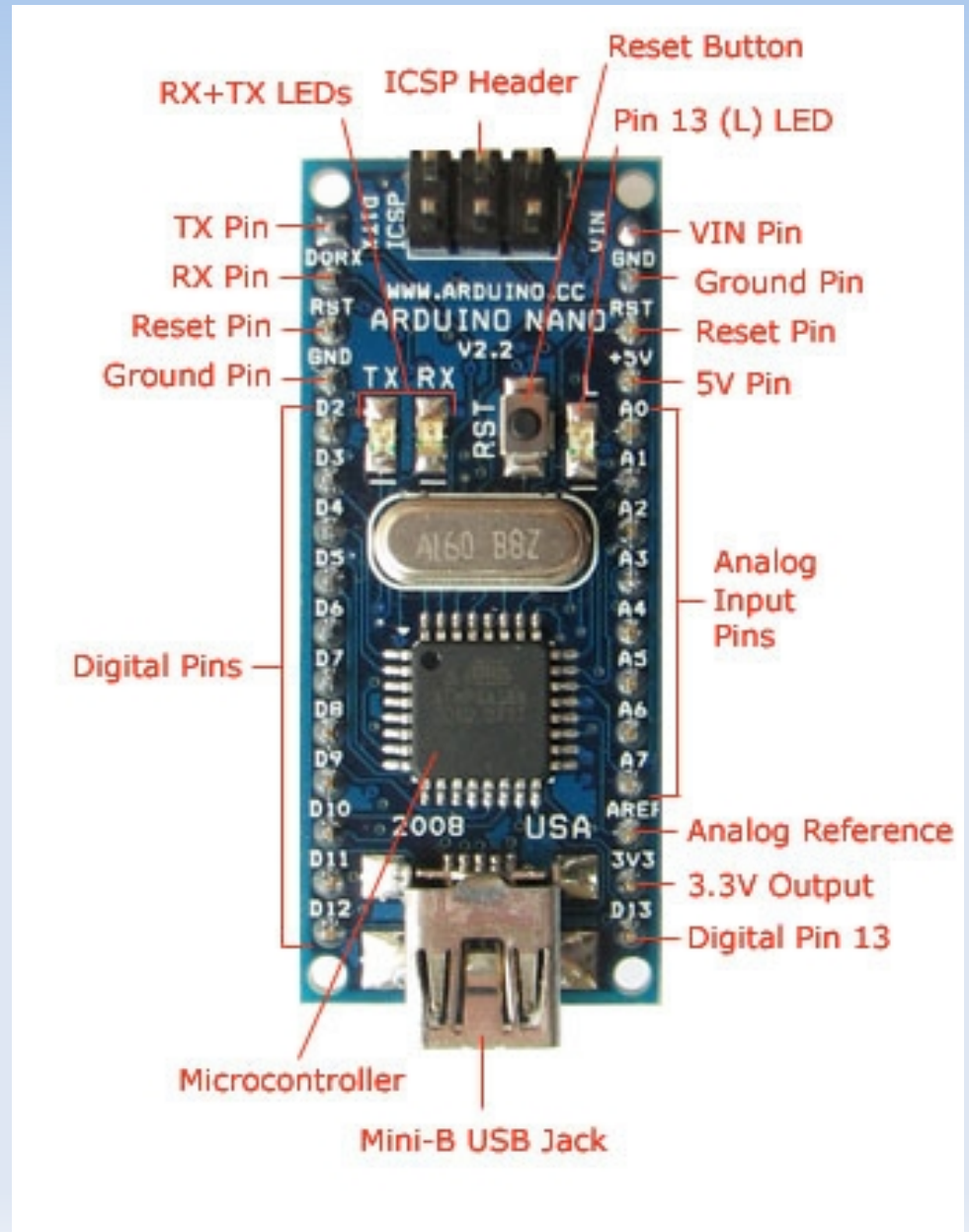
# Choices

- Original Design
  - Atmel Atmega48
  - Arduino Nano
  - INA199 Opamp



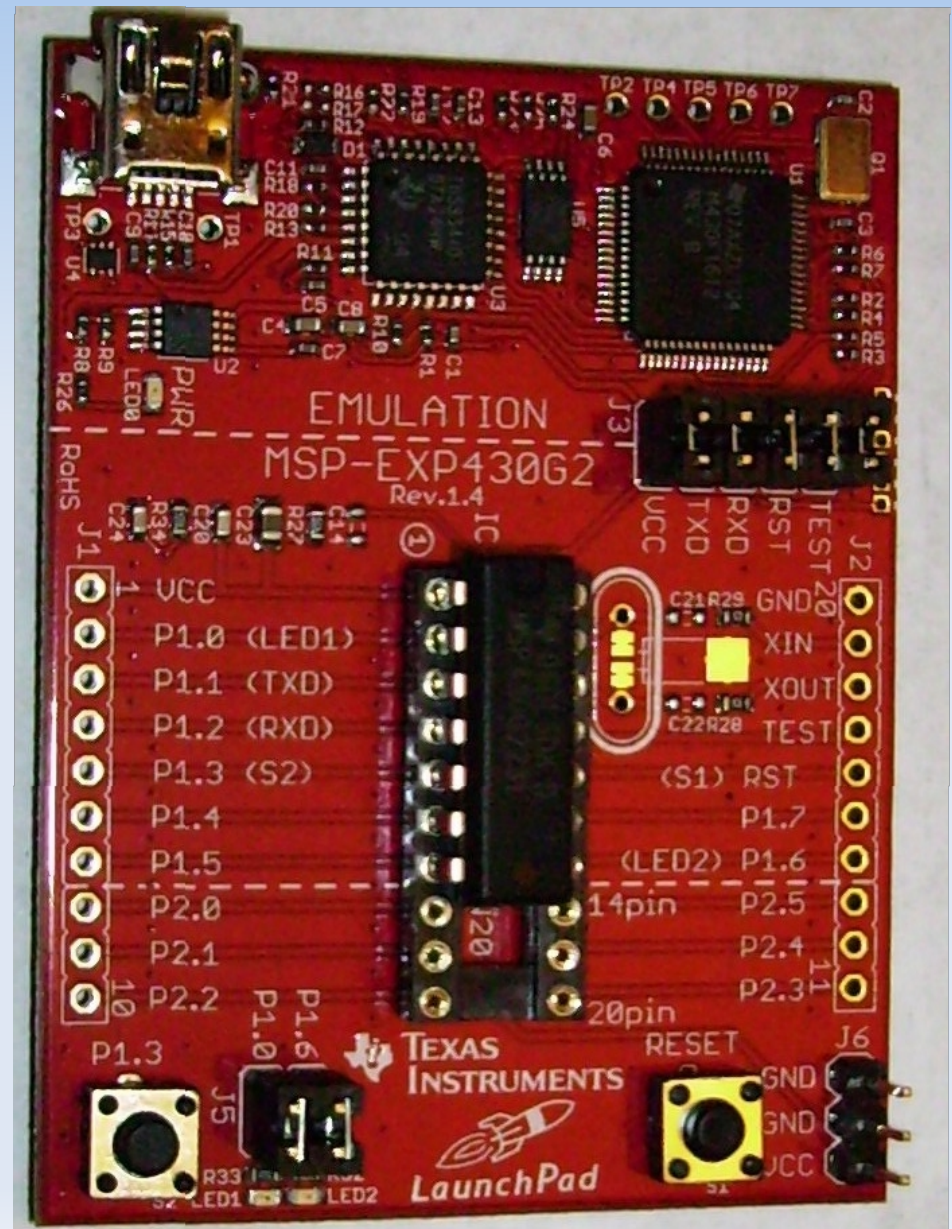
# Choices

- Original Design
- Atmel AVR
  - Low Cost
  - Open Source Tools
  - Limited ADC



# Choices

- Original Design
- Atmel AVR
- TI MSP430
  - Lower Cost
  - Good ADC
  - Limited Tools



# Choices

- Original Design
- Atmel AVR
- TI MSP430
- NXP LPC-2148
  - ARM Toolchain
  - Good ADC
  - Higher Cost



# Choices

- Original Design
- Atmel AVR
- TI MSP430
- NXP LPC-2148
- Data Protocol
  - Transfer Rate
  - Time Stamp
  - Real Time
  - Client

# Conclusion

- Summary
  - Challenges
    - Shunt
    - Opamp
    - Board Modifications

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- Summary
  - Challenges
    - Shunt
    - Opamp
    - Board Modifications
  - Choices
    - Costs
    - Tools
    - Features
    - Data

# Conclusion

Questions?